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Harkness

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(54) **RAILWAY RAIL SUPPORT PLATE**

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E01B 9/42 (2006.01)

(52) **U.S. Cl.**
CPC ***E01B 9/40*** (2013.01); ***E01B 9/42*** (2013.01)

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USPC 238/287, 290, 292, 293, 304, 306
See application file for complete search history.

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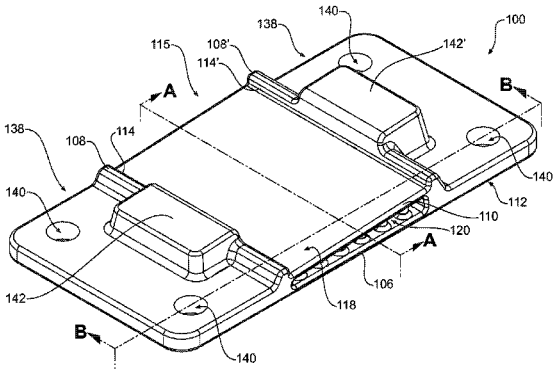
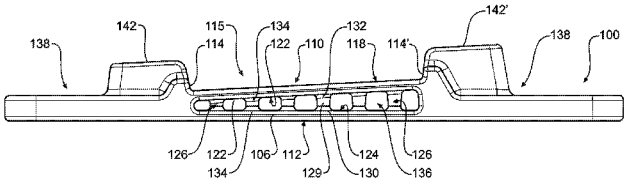
(57) **ABSTRACT**

This invention relates to a support plate for supporting a railway rail on a rail support member, said support plate comprising a lower surface for directly or indirectly contacting a mounting surface of the rail support member, an upper surface for directly or indirectly supporting the rail, and an intermediate region interposing the upper and lower surfaces, for reducing support plate weight.

21 Claims, 14 Drawing Sheets





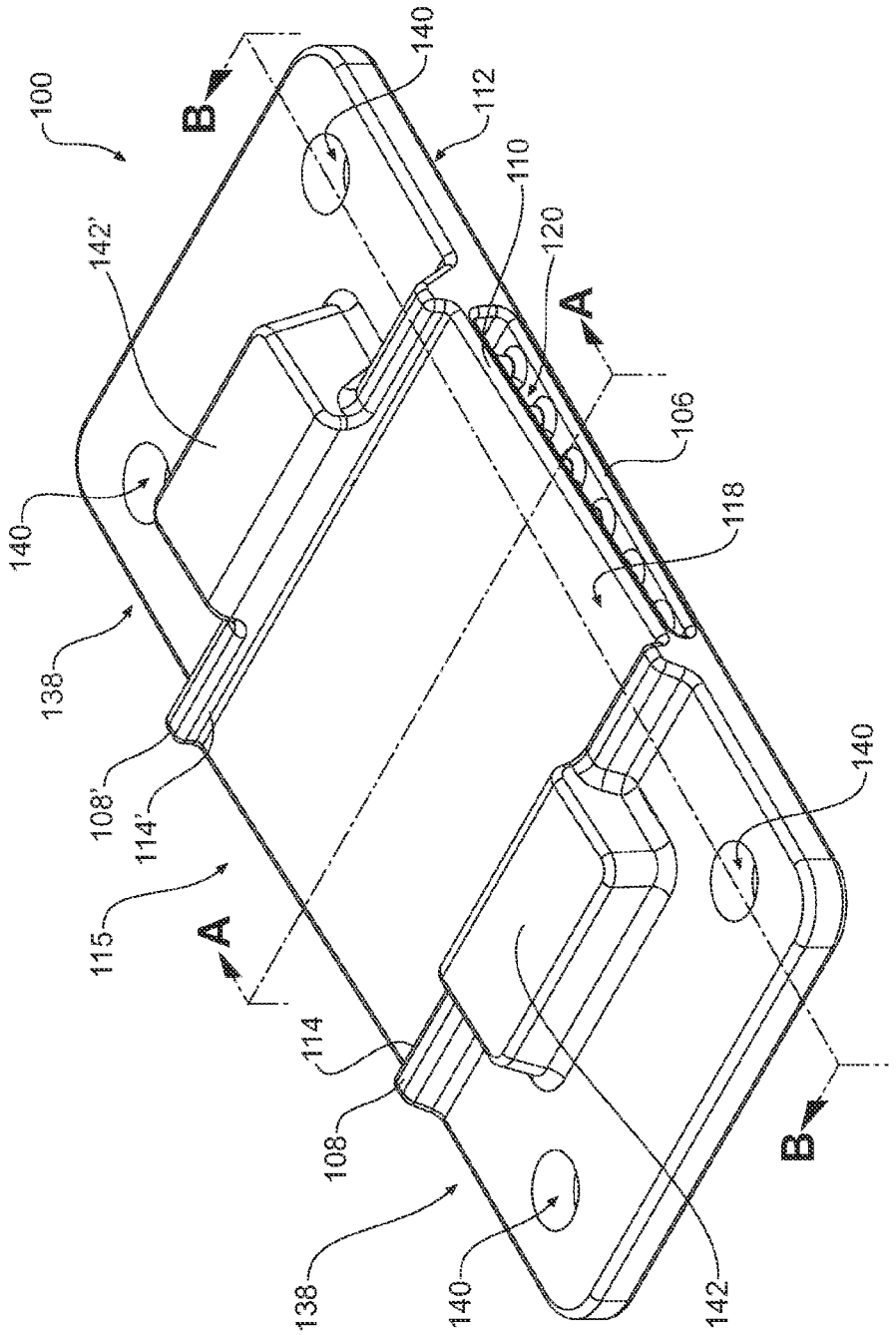
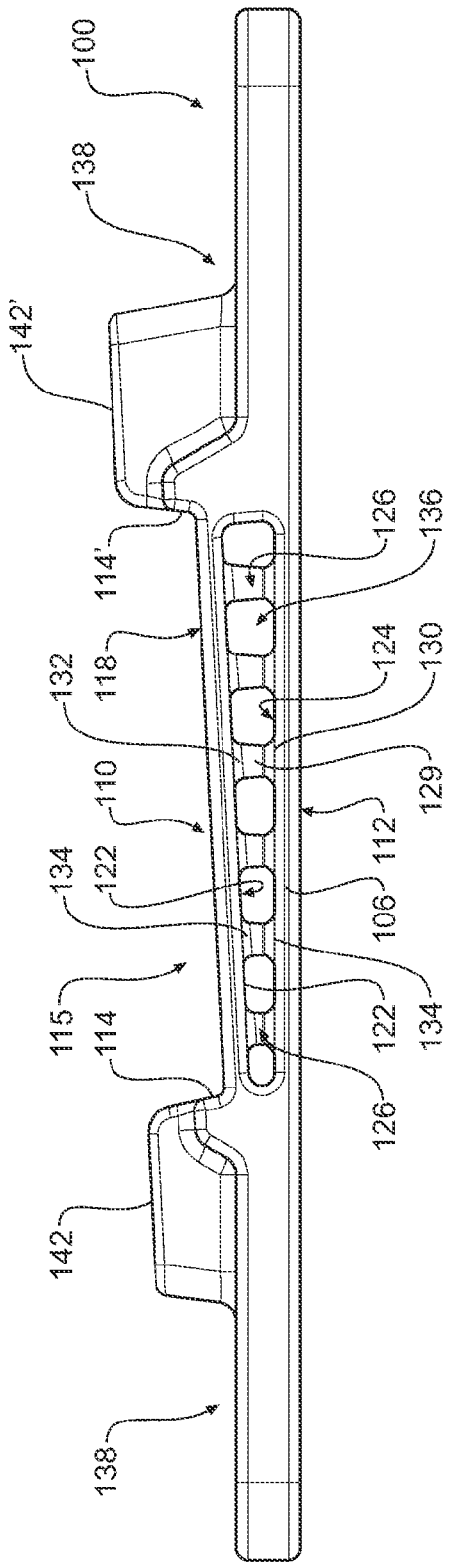

100
B
140
112
110
120
142'
A
106
118
140
138
108'
114'
115
A
114
108
B
138
140
142

Figure 1


100
138
142'
114'
126
136
132
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138

Figure 2

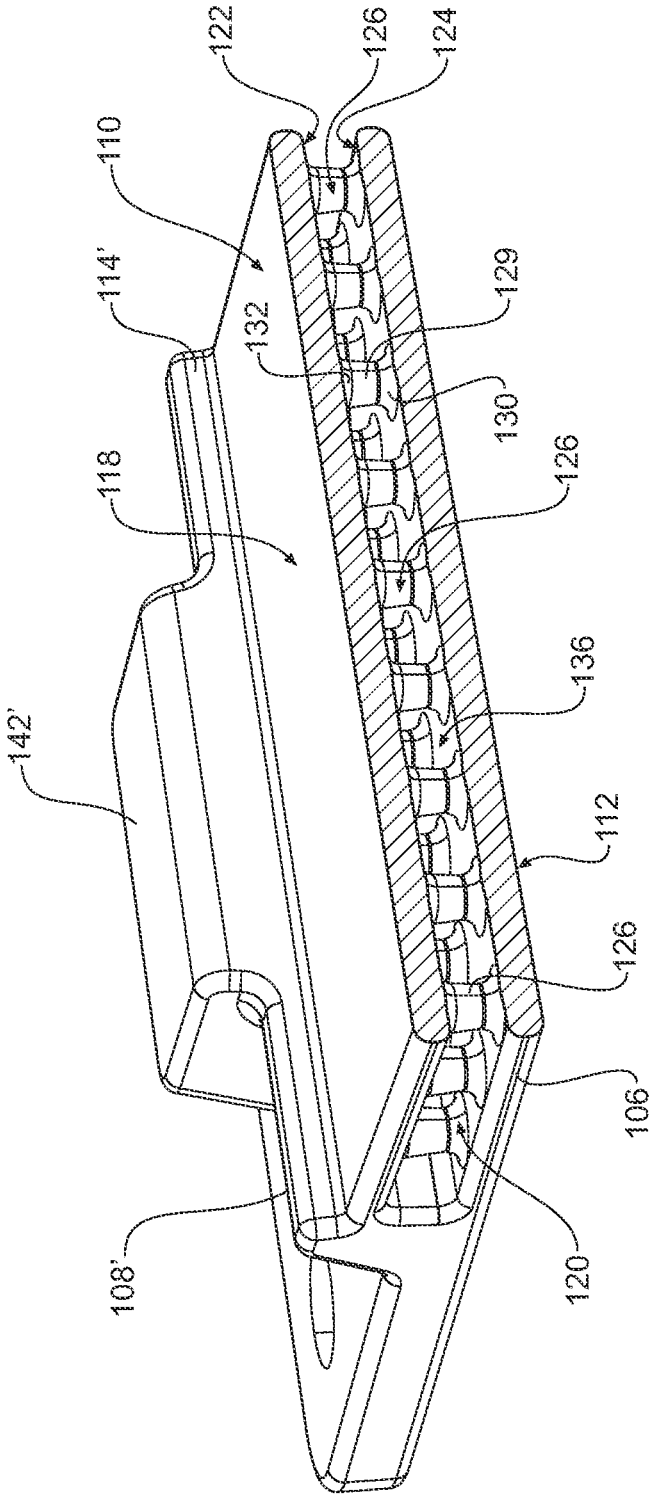

Figure 3
Section A-A

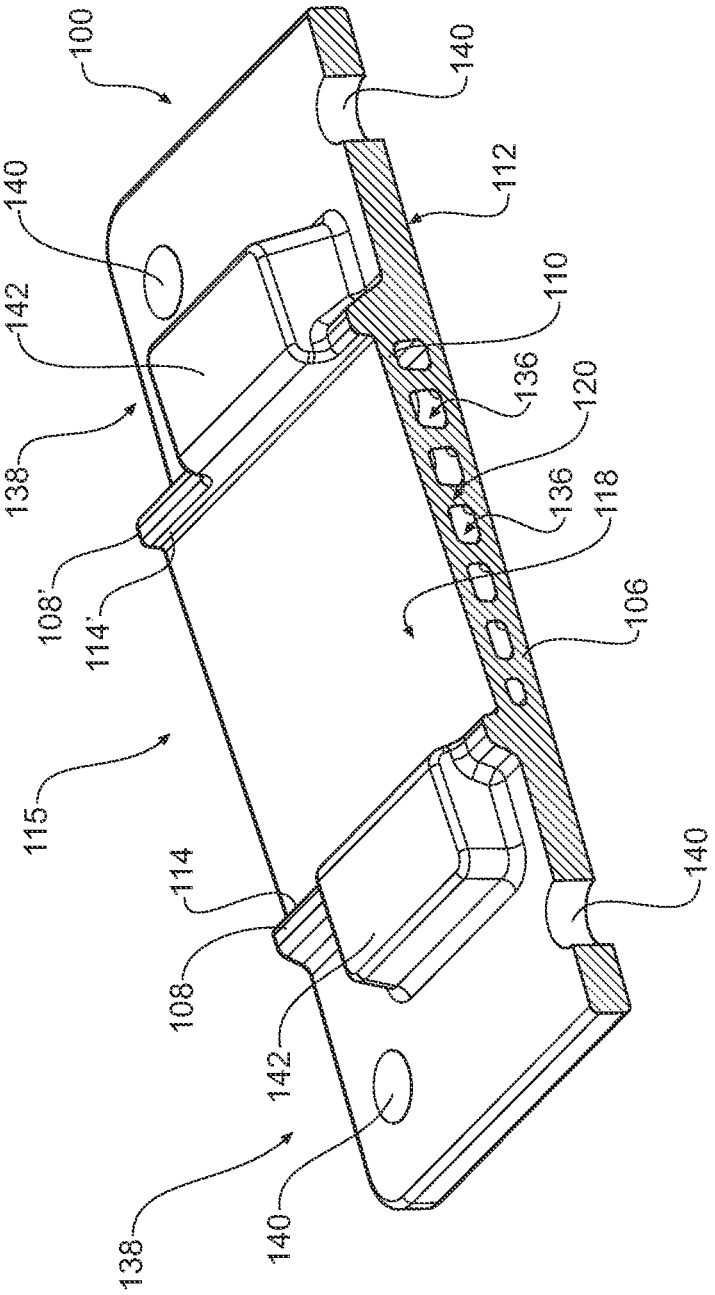

Figure 4
Section B-B

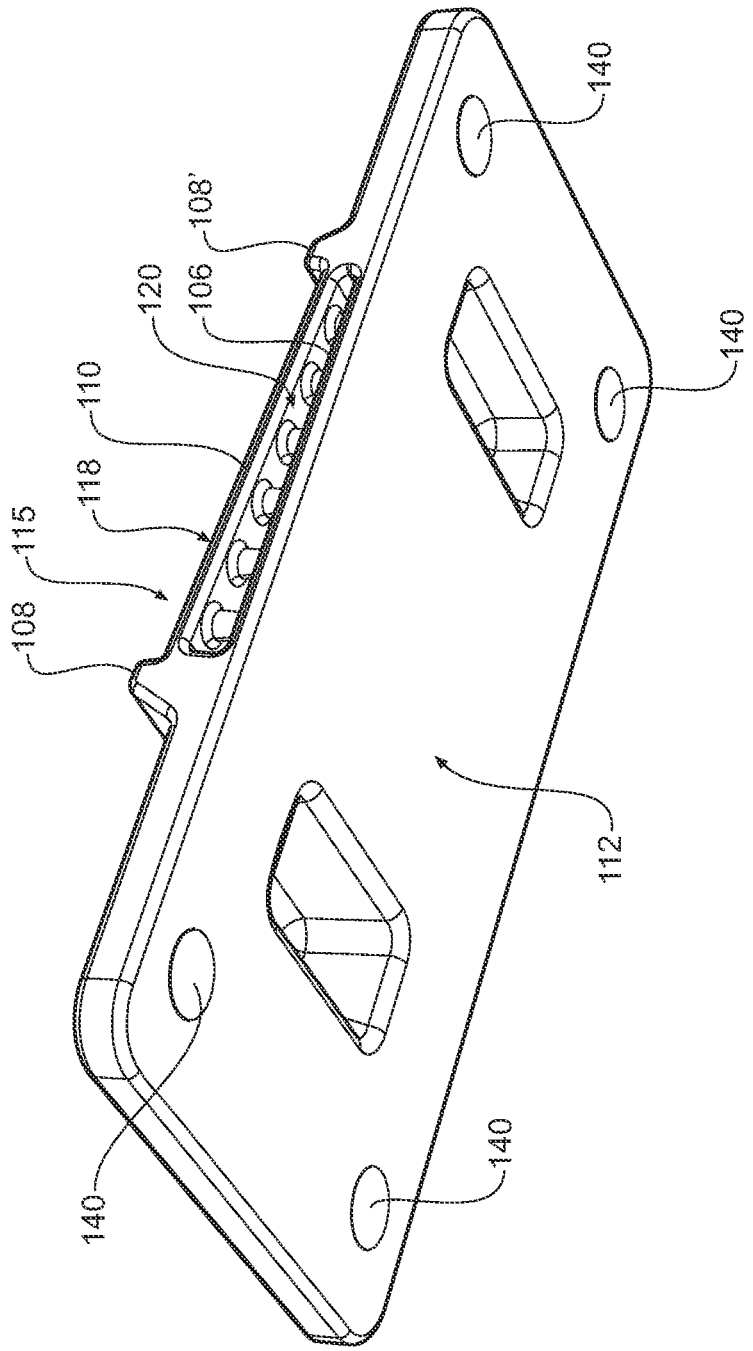

Figure 5

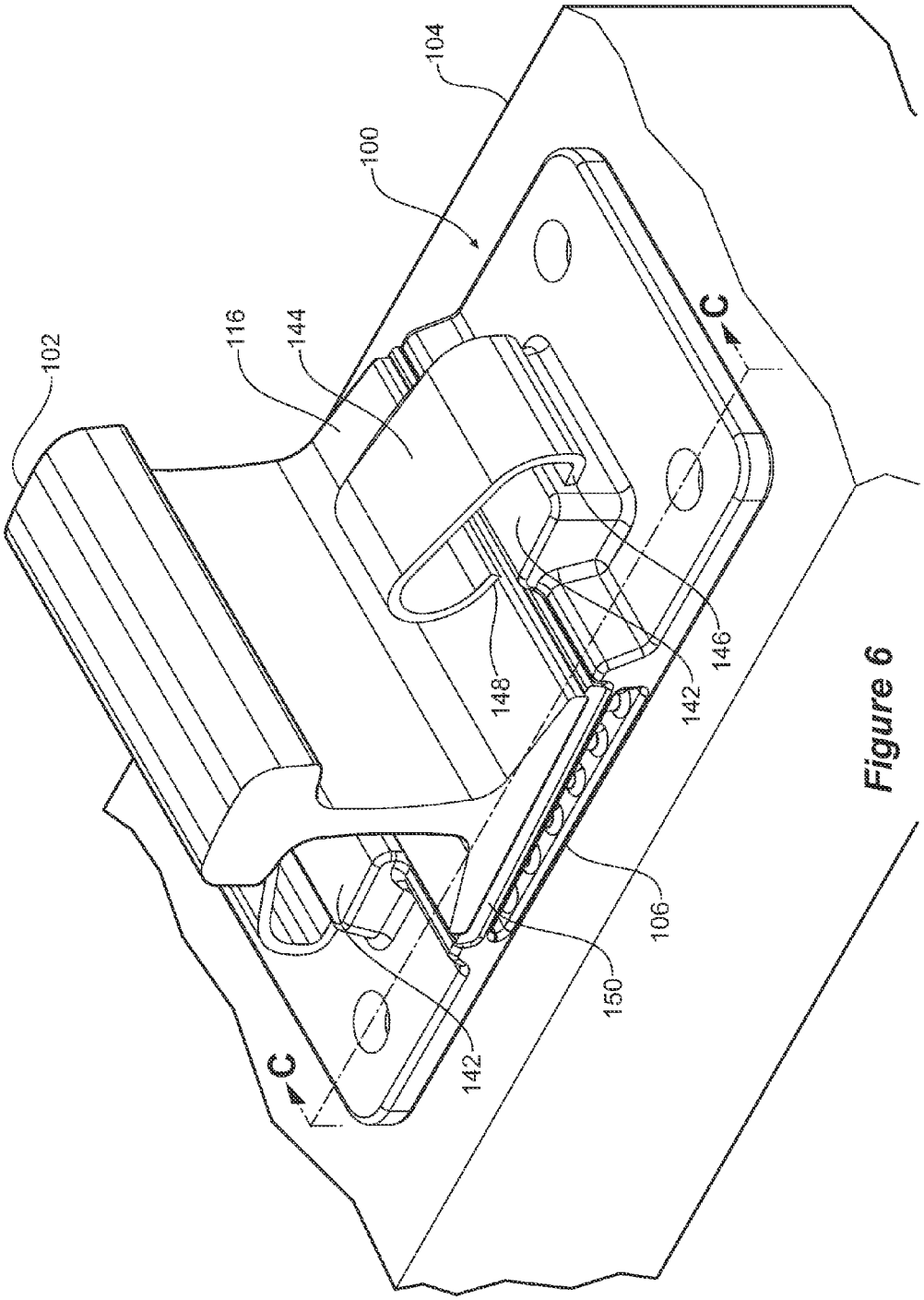

Figure 6

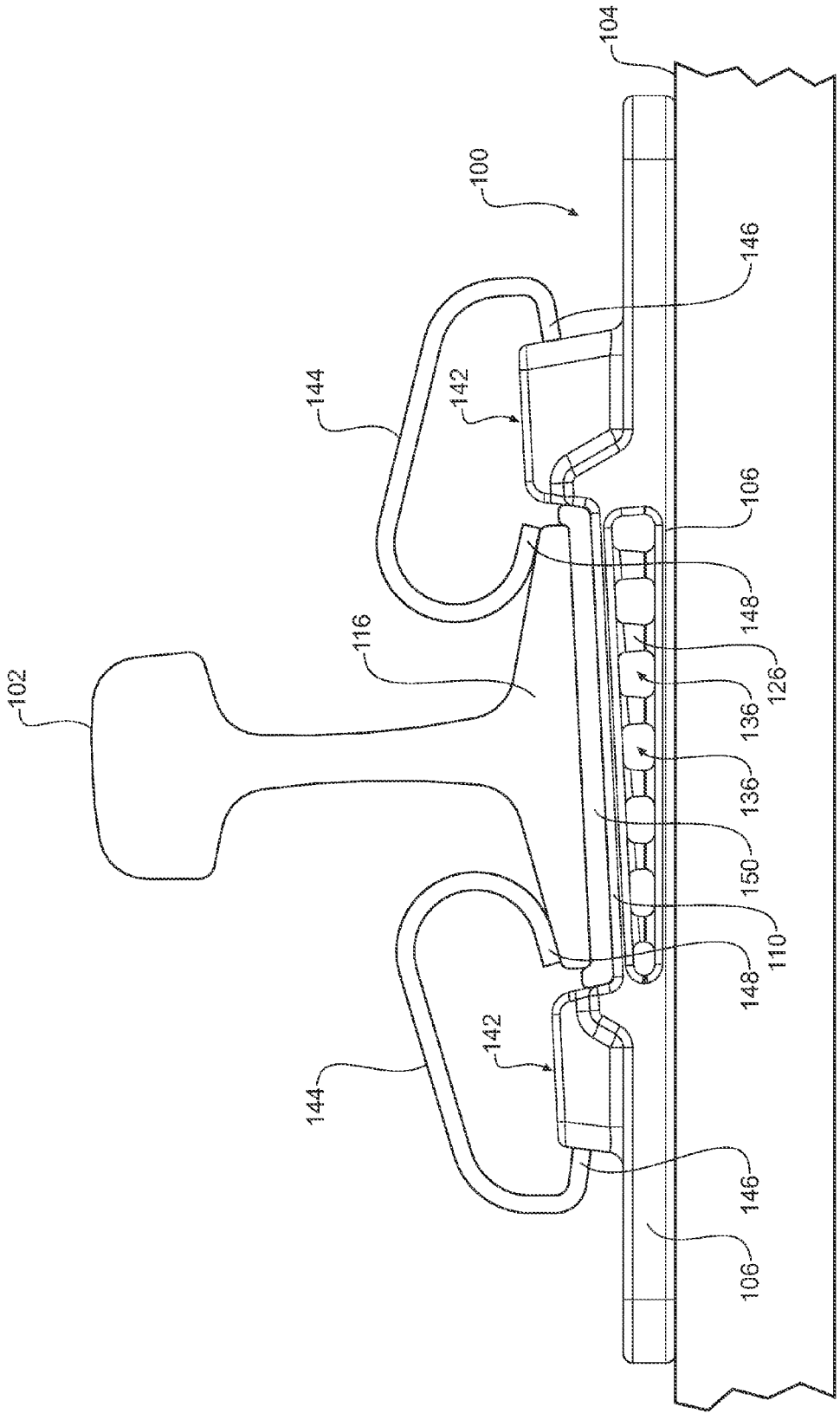
104
100
146
144
142
106
148
116
102
126
136
136
150
110
148
142
144
146
106

Figure 7

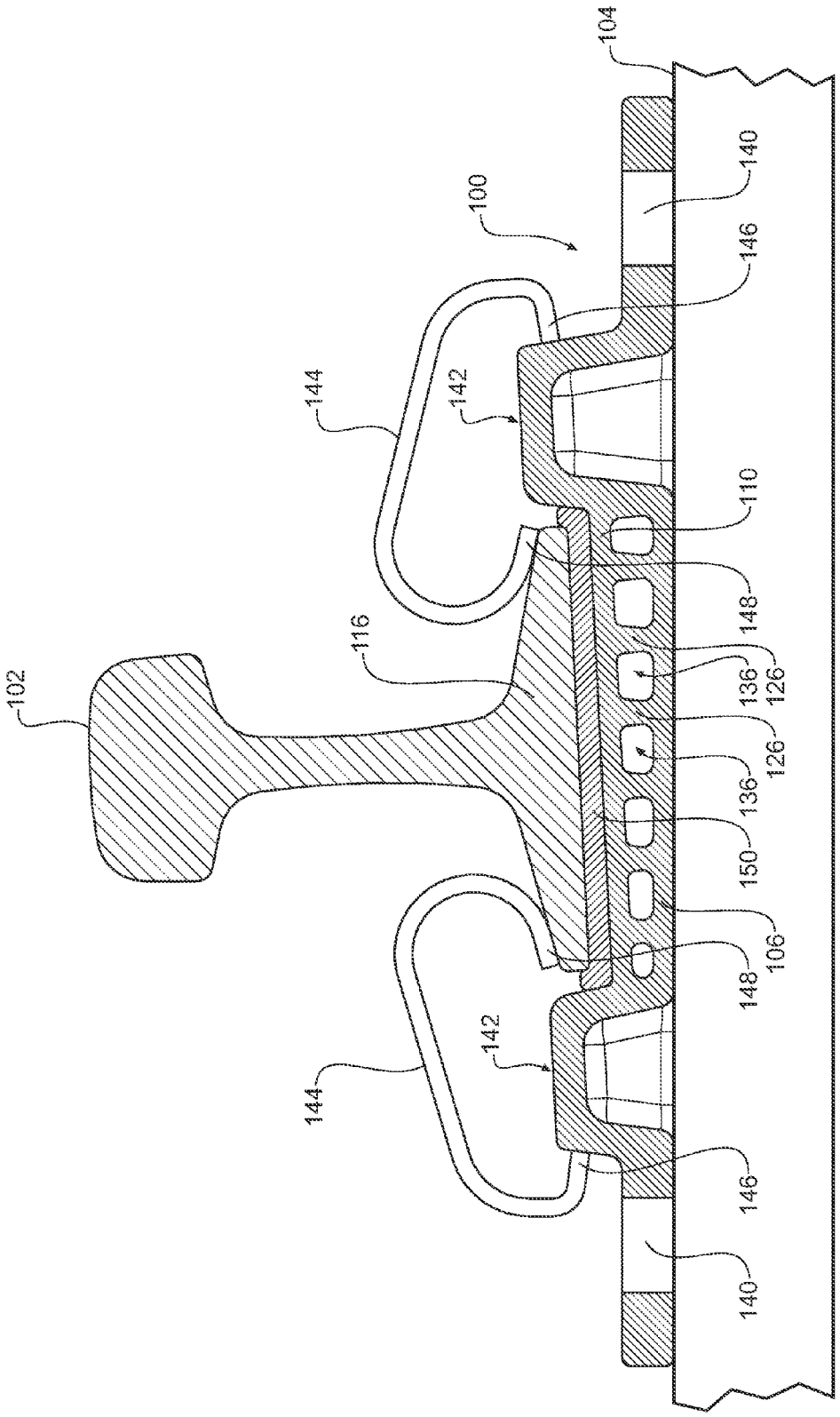

Figure 8
Section B-B

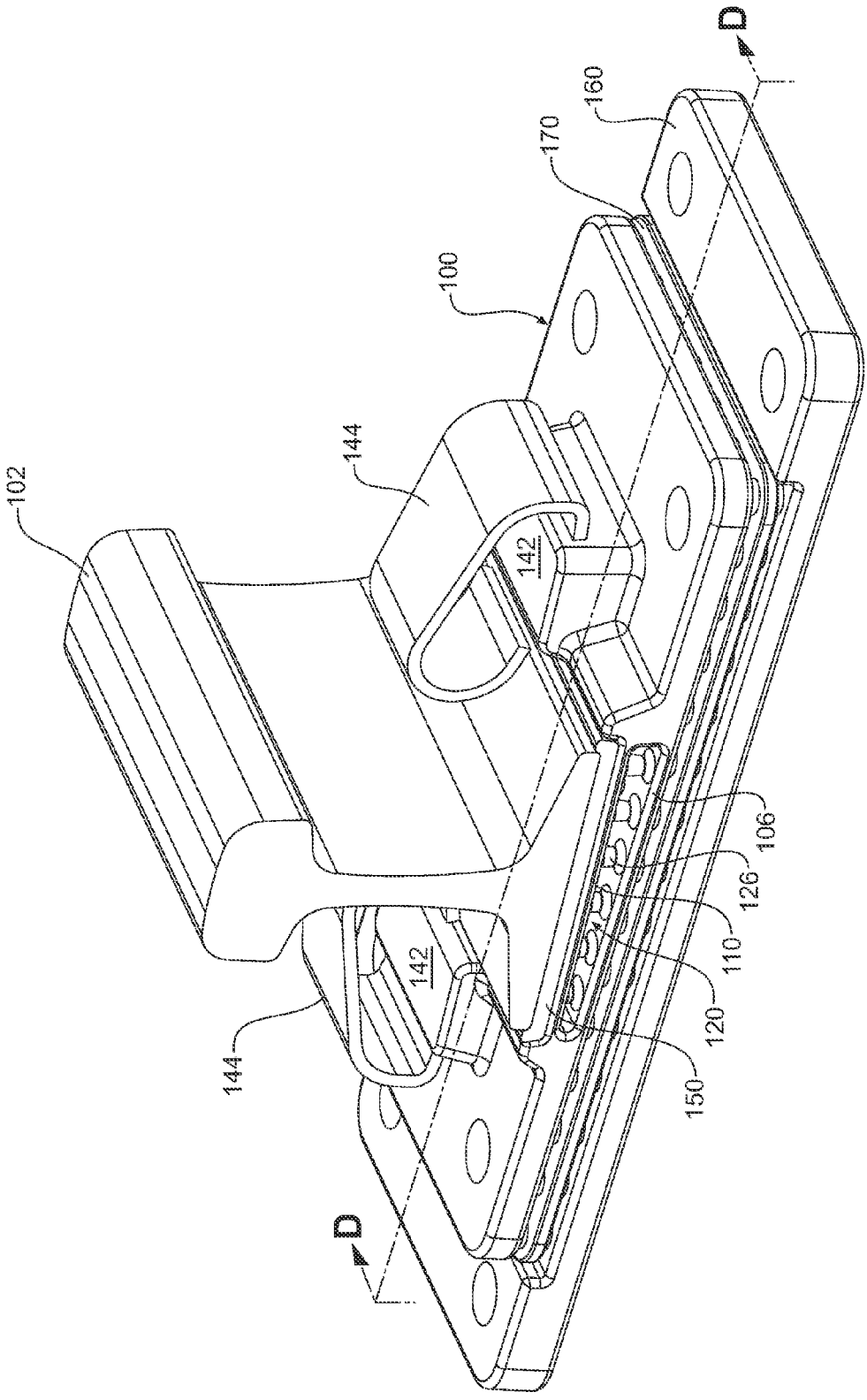

Figure 9

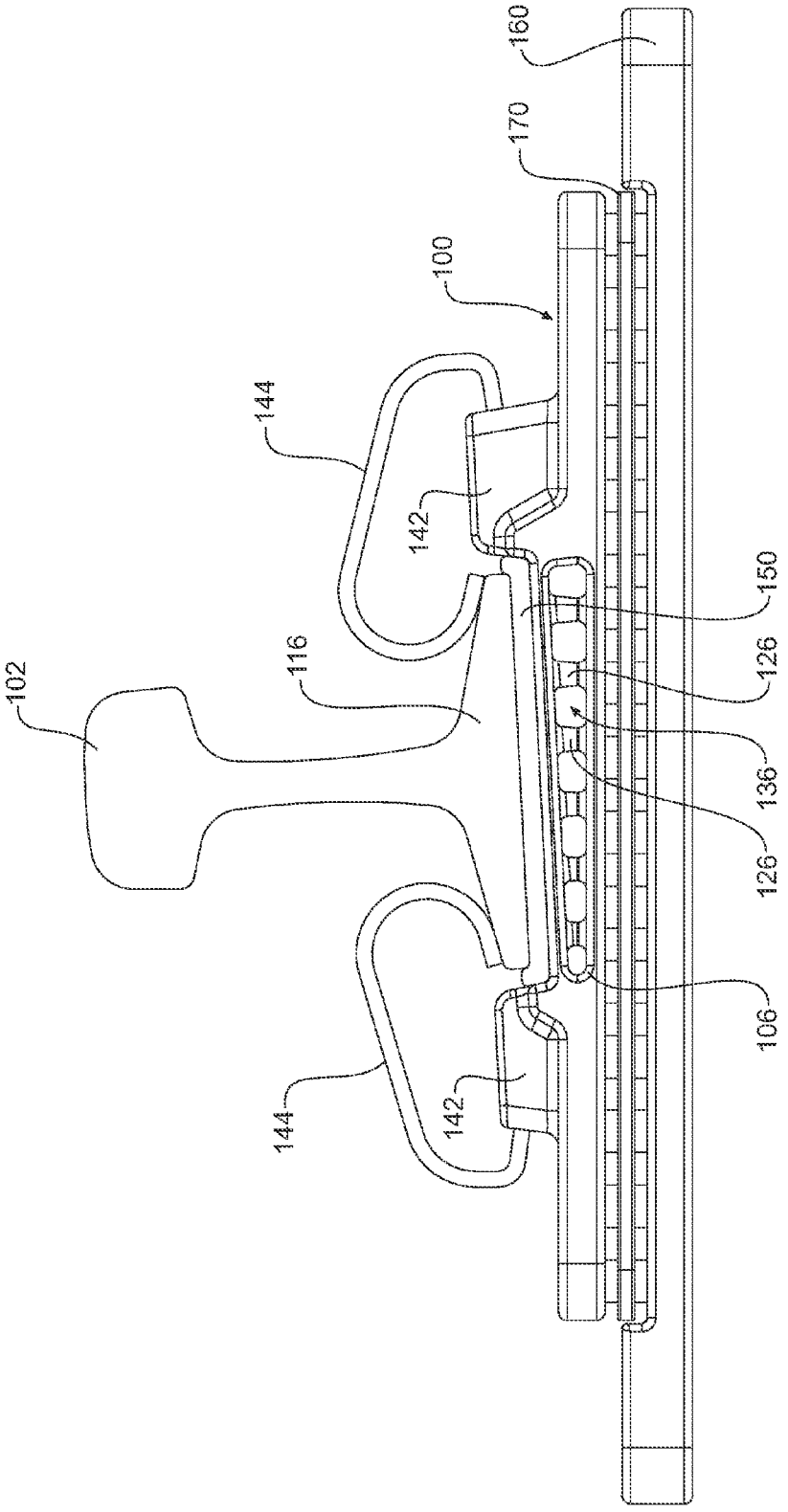

Figure 10

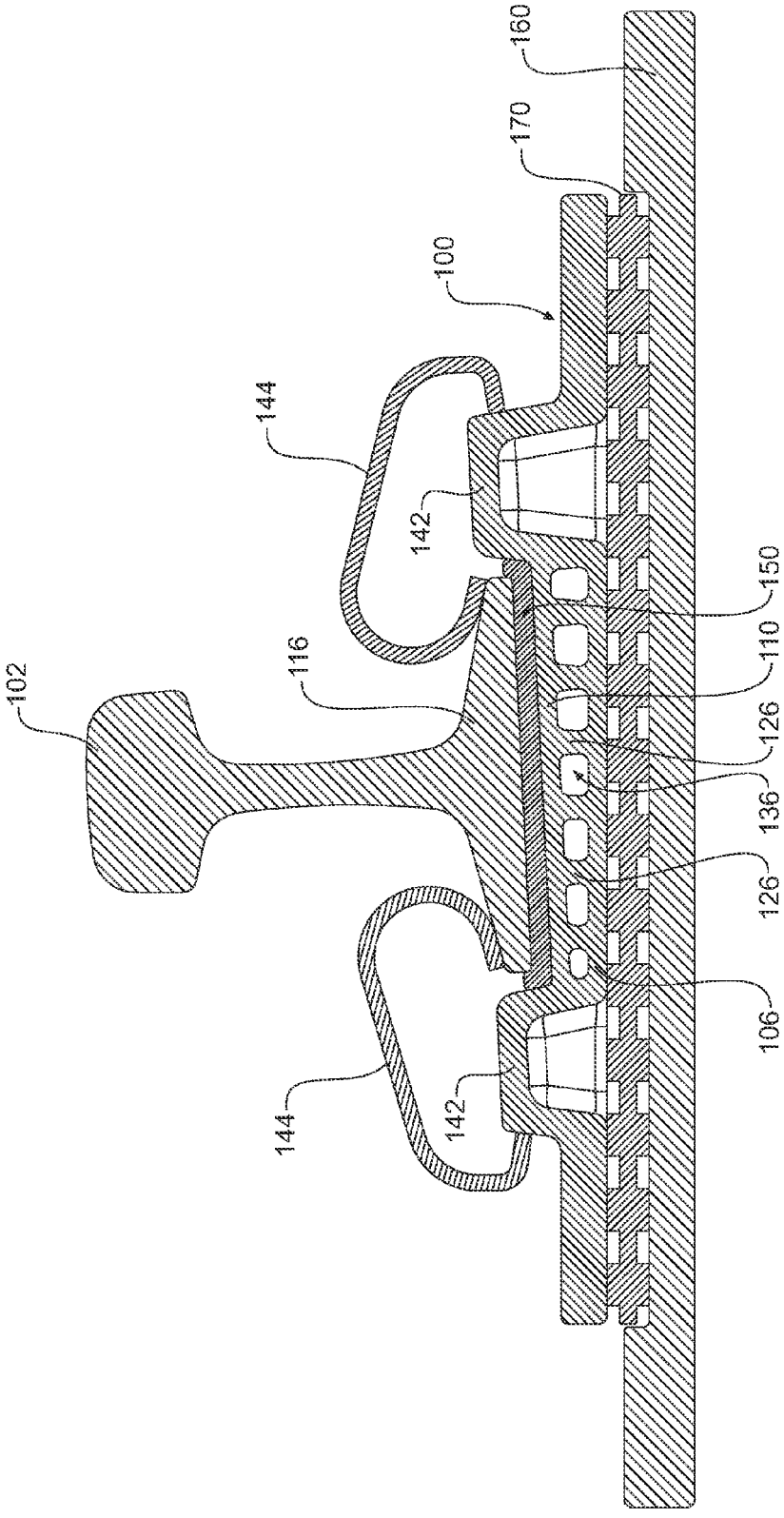

Figure 11
Section D-D

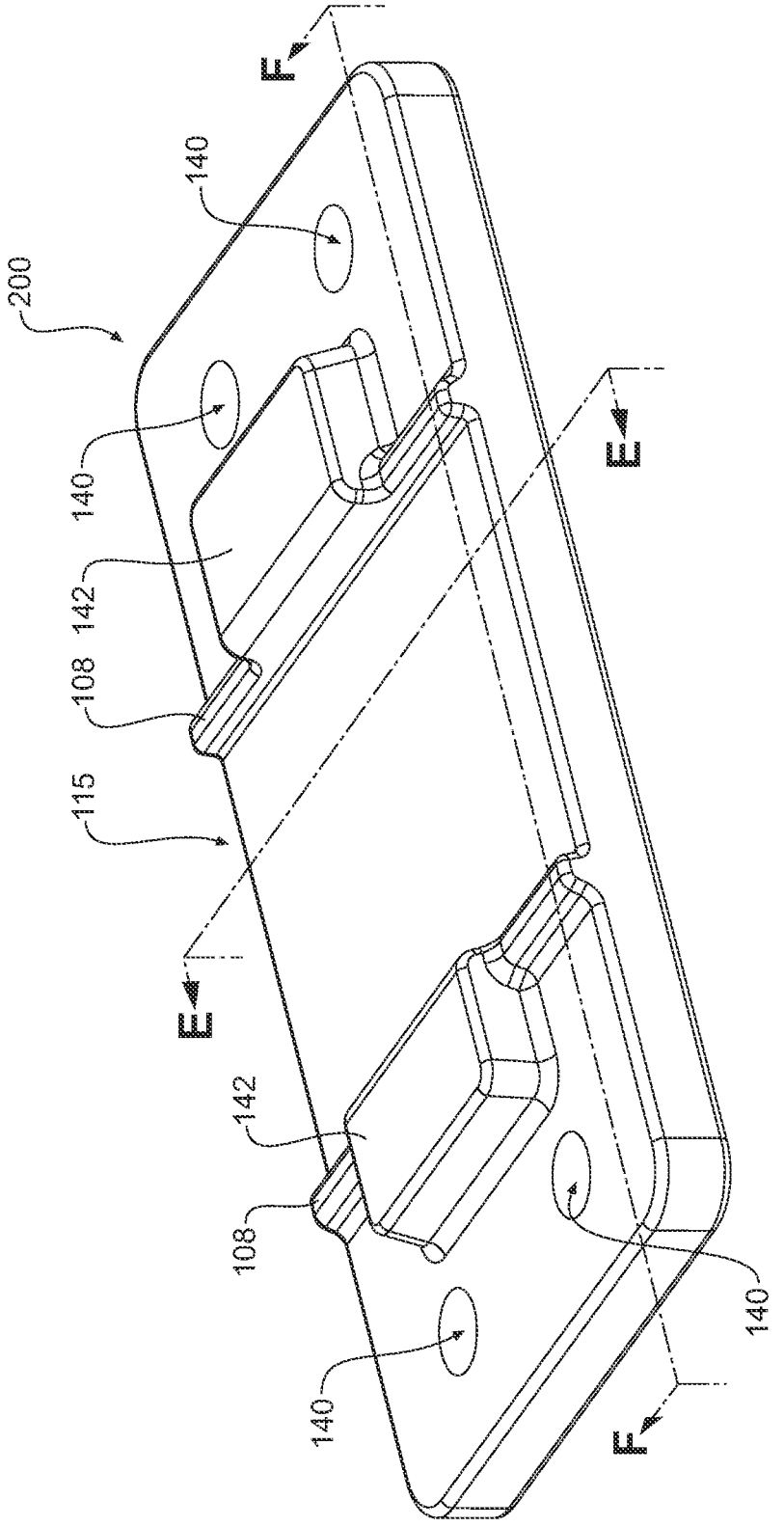

Figure 12

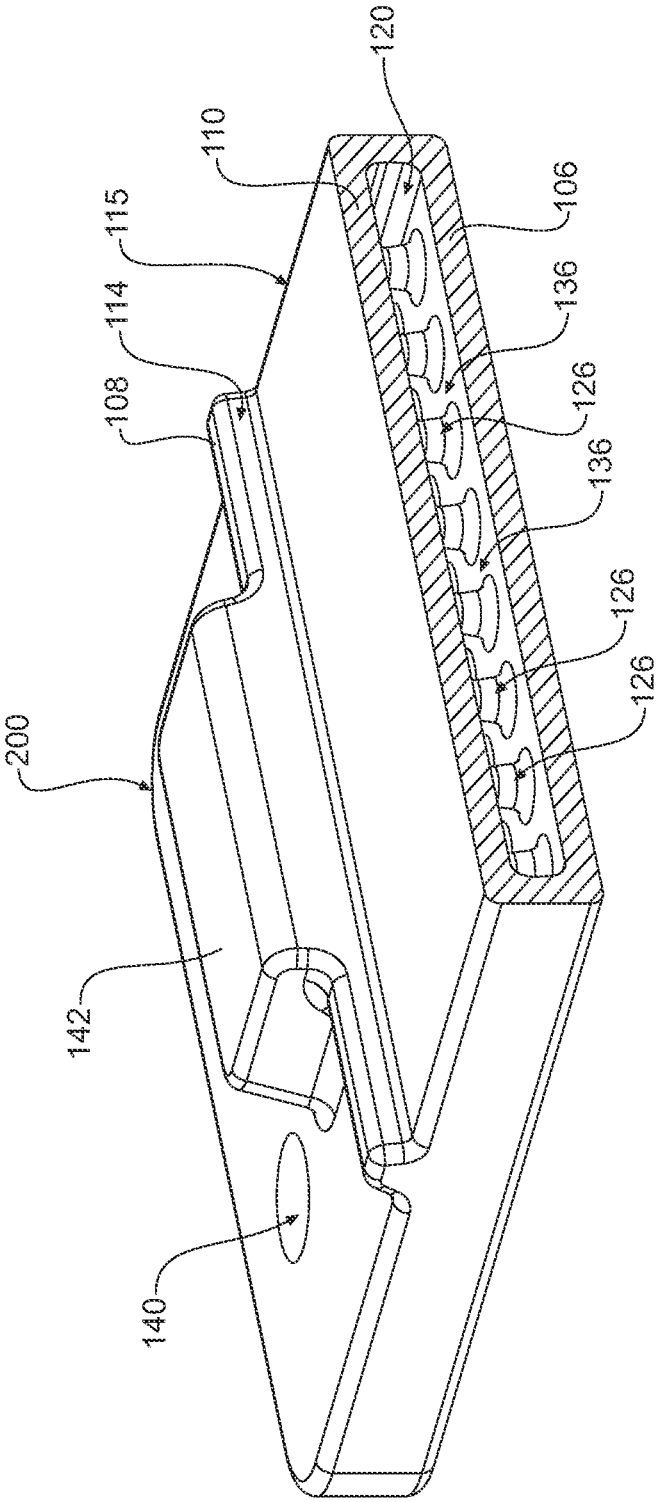

Figure 13
Section E-E

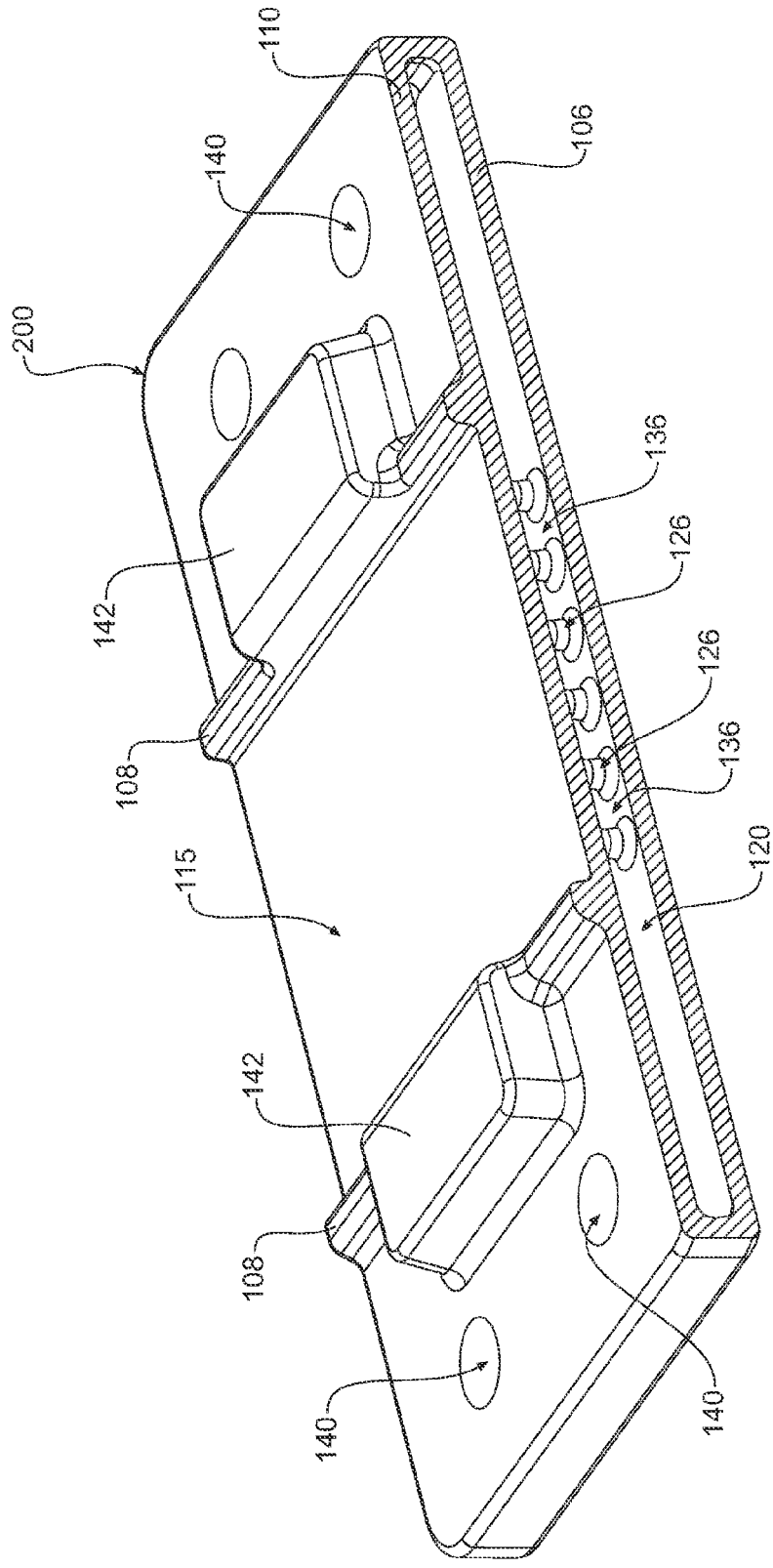

Figure 14
Section F-F

RAILWAY RAIL SUPPORT PLATE

CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a National Stage Application claiming the priority of co-pending PCT Application No. PCT/AU2012/000587 filed May 25, 2012, which in turn, claims priority from Australian application No. 2011902033, filed May 25, 2011. Applicant claims the benefits of 35 U.S.C. §120 as to the PCT application and priority under 35 U.S.C. §119 as to the said Australian application, and the entire disclosures of both applications are incorporated herein by reference in their entireties.

FIELD OF THE INVENTION

The present invention relates to railway, system construction. More particularly, the present invention relates to support plates that secure a railway rail to a rail support member such as a railway sleeper, concrete base, or the like.

BACKGROUND OF THE INVENTION

Railway systems involve sets of tracks, each track including one or more railway rails. Each rail is secured to support members to form the track over which a train may run. The support members may include a cross member such as a "railway sleeper", or a concrete base, steel support, or the like.

In practice, each rail may be secured to a support member using a support plate which is located between a foot of the rail and a supporting surface of the support member. Such a support plate may include, for example, a "tie plate" or a "turnout plate". In terms of supporting a rail to a railway sleeper, each support plate is fixed to the sleeper using a suitable fixing such as a threaded fastener or spike (large nail), with the actual fixing depending on the sleeper design and material. The rail is then secured to the support plate, and thus to the sleeper, using another fixing, which may include a tie clip. In operation, each sleeper is usually supported by a foundation comprising a ballast material. A sleeper may thus include upper and lower surfaces for contacting a tie plate and ballast respectively.

Railway system construction involves transporting large numbers of components across large distances. Typically the components are transported in high volume containers, such as shipping containers. Such transportation incurs significant transport costs. Indeed, the transportation demands are such that even a slight reduction in component weight can lead to a significant reduction in transportation costs. For example, because some transportation systems are weight restricted, a reduction in the weight of a particular component may mean that a larger number of those components may be transported for a particular weight restriction.

Because of the need for load bearing components, such as the support plate, to meet particular structural demands and provide structural integrity over an extended operational life, a significant challenge in component design involves reducing component weight whilst maintaining the required structural performance.

One approach for reducing the weight of a support plate involves forming a series of grooves or slots on the surface of the support plate in contact with the support member to reduce material mass. Unfortunately, incorporating grooves on the surface of the support plate in contact with the support member may lead to a reduction in the operational life of the

support member, at least. For example, as a train moves along a rail and across the railway support member, the support member supports the weight of the train. The train movement may create slight movements and frictional forces between the contacting surfaces of the support plate and the support member. Over time, these frictional forces may contribute to wear of the support plate or the support member, which may ultimately result in the support plate or the support member requiring removal and replacement, thus limiting the operational life. The extent to which the support plate contributes to the frictional forces, and thus the degradation of the support member, depends at least to some extent on the interface between the support plate and the support member.

It is against this background that the problems and difficulties associated therewith that the present invention has been developed.

Certain objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

SUMMARY OF THE INVENTION

In a first aspect the present invention may be said to reside in a support plate for supporting a railway rail on a rail support member, said support plate comprising a lower surface directly or indirectly supported on a mounting surface of the rail support member, an upper surface for directly or indirectly supporting the rail, and an intermediate region interposing the upper and lower surfaces, for reducing support plate weight.

In one form, the support plate further comprises a base comprising the lower surface, a deck disposed above the base and comprising the upper surface, and wherein the intermediate region is interposing and separating the base and the deck.

In one form, the intermediate region is or comprises a hollow region.

This intermediate (and hollow in some cases) region may be so extensive as to largely fill the support plate (or largely render it hollow). Moreover, the intermediate region may be externally visible, or substantially enclosed and therefore mostly, if not completely, concealed.

In one form, the intermediate region comprises one or more support elements for supporting the deck.

In one form, the or each support element extends from the base to the deck.

In one form, the intermediate region is at least partially occupied by a material having different material properties to the deck and the base.

In a further aspect, the invention may be said to reside in a support plate for supporting a railway rail on a support member, said plate including:

- a base including a lower surface for contacting a mounting surface of the support member;
- a deck including an upper surface for supporting a foot of the rail, said deck disposed above the base; and
- an intermediate region interposing the deck and the base, said intermediate region including one or more support elements for supporting the deck.

In one form, the support plate is one of an assembly of plates supporting a rail on a rail support member.

In one form, the support plate may include a tie plate or a turnout plate.

In one form, the support plate is a lowermost or base plate of the assembly.

The support member may include a railway sleeper, a concrete base (such as a concrete slab), or a steel structure.

Embodiments of the present invention may include one or more shoulders which extend upwardly from the base. It is preferred that the shoulders are arranged to locate the foot on the upper surface. In one embodiment, the support plate includes a pair of shoulders where the deck extends between them.

The intermediate region may include a hollow region or a partially hollow region. The intermediate region may include one or more passages which extend through the support plate to allow moisture egress, such as water egress, from the support plate when in use.

In one form, the support elements are configured and arranged to transfer and distribute a load placed on the upper surface to and (optionally) across the base. In one form, each support element extends from the base to the deck.

The support elements may include pillar (or column)-like elements. However, in alternative embodiments the support elements may have other configurations. For example, in one embodiment the support elements include one or more generally longitudinal elements, such as rib-like elements, extending across a horizontal extent of the intermediate region. Other configurations may also be possible.

In an embodiment which includes support elements in the form of pillar-like elements, the pillar-like elements may have substantially the same horizontal cross-section. However, it is not essential that the pillar-like elements have substantially the same horizontal cross-section since in other embodiments it is possible that the pillar-like elements may have a horizontal cross-section which depends on the location within the intermediate region.

The pillar-like elements may include generally cylindrically shaped bodies. This generally cylindrically shaped body may have a diameter of 4 mm upwards, but generally in the range of 4 to 20 mm. Cylindrically shaped pillar-like elements are expected to provide a suitable balance between strength/weight ratio and manufacturing cost. However, other geometries may also be possible, such as, faceted or multi-faceted geometries. Other suitable geometries include diamond shaped, square shaped, or frusto-conical shaped support elements.

The cross section of the pillar-like elements should be large enough to facilitate manufacture and carry the expected load, but small enough to reduce the weight of the support plate whilst providing desired structural characteristics.

In one form, the pillar-like elements are disposed in a substantially uniform arrangement. In other words, the pillar-like elements are substantially uniformly spaced within the intermediate region. However, it is not essential that the pillar-like elements be so disposed since in other embodiments the arrangement of the pillar-like elements may depend on the expected distribution of load across the upper surface so that, for example, there is a greater density of pillar-like elements in areas of higher load. Similarly, the geometry of the pillar-like elements need not be uniform but could instead vary according to the expected load distribution across the upper surface so that, for example, pillar-like elements in areas of higher expected load may have a larger horizontal cross sectional area than those in areas of lower expected load. Optimizing the arrangement and/or geometry of the pillar-like elements according to the expected distribution of load across the upper surface may lead to further weight reductions.

In an embodiment, the intermediate region is at least partially occupied by a material having different material properties to the deck and the base. The material may form a layer between the deck and the base. The material may include at least one of:

a. a rubber composition;
b. plastic;
c. a composite material;
d. metal;
e. concrete;
f. foam; or
g. an epoxy resin based material.
h. sand

In some embodiments, the material includes a resilient material which is inserted into the intermediate region to improve the compressive and tensile properties of the support plate.

A support plate in accordance with an embodiment may be manufactured as a one-piece component from a material having suitable mechanical properties using a suitable manufacturing process. One example of a suitable manufacturing process is sand casting. In some embodiments, the support plate is a cast-iron product. However, it is to be appreciated that other manufacturing processes and materials may be used. For example, in other embodiments the tie plate may be a machined, forged, or welded product. Other suitable materials and manufacturing processes would be well within the knowledge of a skilled addressee.

BRIEF DESCRIPTION OF THE DRAWINGS

An illustrative embodiment of the present invention will be discussed with reference to the accompanying drawings wherein:

FIG. **1** is a top isometric view of a tie plate according to a first embodiment of the present invention;

FIG. **2** is an end view of the tie plate illustrated in FIG. **1**;

FIG. **3** is a sectional view of the tie plate illustrated in FIG. **1**, when sectioned along the line A-A;

FIG. **4** is a sectional view of the tie plate as illustrated in FIG. **1**, when sectioned along the line B-B;

FIG. **5** is bottom view of the tie plate shown in FIG. **1**;

FIG. **6** is top isometric view of the tie plate illustrated in FIG. **1** forming part of an assembly supporting a rail;

FIG. **7** is an end view of the assembly illustrated in FIG. **6**;

FIG. **8** is a sectional view of the tie plate illustrated in FIG. **6**, when sectioned along the line C-C;

FIG. **9** is a top isometric view of the assembly illustrated in FIG. **6**, further comprising additional members supporting the tie plate and rail;

FIG. **10** is an end view of the assembly illustrated in FIG. **9**;

FIG. **11** is a sectional view of the assembly illustrated in FIG. **10**, when sectioned along the line D-D;

FIG. **12** is a top isometric view of a tie plate according to a first embodiment of the present invention;

FIG. **13** is a sectional view of the tie plate illustrated in FIG. **12**, when sectioned along the line E-E; and

FIG. **14** is a sectional view of the tie plate illustrated in FIG. **12**, when sectioned along the line F-F.

In the following description, like reference characters designate like or corresponding parts throughout the several views of the drawings.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENT

The drawings in the present application and their accompanying detailed description are directed to merely example embodiments of the invention. To maintain brevity, other

embodiments of the invention which use the principles of the invention are not specifically described in the present application and are not specifically illustrated by the present drawings.

The below described embodiment of the present invention relates to a support plate in the form of a tie plate for securing a rail to a rail support member in the form of a sleeper. However, it is to be understood that the present invention is not intended to be limited to tie plates nor to use with a particular type of rail support member. For example, other embodiments of the present invention provide other forms of support plates, such as a turnout plate, or indeed support plates for use with other rail support members, such as in cases where the support plate is one of an assembly of plates supporting a rail on a rail support member, and the support plate is any one of the plates in the assembly.

Accordingly, although the below description relates to a tie plate, it is to be understood that the invention is not to be so limited. It is also to be understood that support plates according to embodiments of the present invention may be used with a variety of rail support members.

FIGS. **1** to **5** illustrate a tie plate **100** according to an embodiment of the present invention. FIGS. **6** through **8** illustrate the tie plate **100** supporting a railway rail **102** on a railway sleeper **104** positioned beneath and in contact with the tie plate **100** to transfer the weight of an over-passing train to the sleeper **104**.

The tie plate **100** illustrated in FIGS. **1** to **5** is manufactured from a single piece of metal, such as iron, using a sand casting process. However, it is also possible that the tie plate **100** may be manufactured from other materials, such as rubber, composite, other metals, or indeed any other material sufficient to withstand the load exerted thereon by a train and any other equipment attached or mounted to the tie plate **100** in use. Further, in alternative embodiments, the tie plate **100** may be assembled from separate pieces of material.

The tie plate **100** includes a base **106** and a deck **110** disposed above and spaced apart from the base **106**. The base **106** includes a lower surface **112** (shown as a continuous planar surface) for contacting a correspondingly shaped mounting surface of the sleeper **104**. The deck **110** includes an upper surface **118** (shown as a continuous planar surface) for supporting a foot **116** of the rail **102**, as illustrated in FIGS. **6** through **8**. An intermediate region **120** interposes the deck **110** and the base **106**.

In the illustrated embodiment this intermediate region **120** is externally visible, but the intermediate region **120** can be concealed "as-cast", or it may be concealed by way of a further manufacturing process, such as by welding a cover plate over any opening to the intermediate region **120**.

The illustrated embodiment also includes a pair of shoulders **108**, **108'** for locating the rail foot **116** on the upper surface **118**. In the present case, the shoulders **108**, **108'** extend upwardly from the base **106** and laterally across the width of the tie plate **100**. The shoulders **108**, **108'** include oppositely facing walls **114**, **114'** which are spaced apart by substantially the same extent as the width of the rail foot **116** to be located on the upper surface **118**. It is to be noted that it is not essential that embodiments of the present invention include shoulders **108**, **108'** as in some embodiments shoulders may not be required to locate the rail foot **116** on the upper surface **118** of the deck **110**. Nonetheless, it is preferred that shoulders **108**, **108'** be provided. It is to be noted that in embodiments of the present invention which include shoulders, the number, shape and arrangement of the shoulders may be different to shoulders **108**, **108'**.

As shown in FIG. **1**, in the illustrated embodiment the deck **110** extends between the shoulders **108**, **108'**. The upper surface **118** of the deck **110** cooperates with the walls **114**, **114'** of the shoulders **108**, **108'** to form a receiving region **115** or "seat" for receiving the foot **116** of the rail **102**. In the embodiment illustrated the upper surface **118** is canted at an angle of about 1.4 degrees relative to the base **106** so that when mounted on the sleeper **104** the tie plate **100** sets the cant of the rail **102**. The degree of cant can be set to suit the intended application, but cants in the range of 1 to 3 degrees are most common. As shown, the deck **110** is disposed above and spaced apart from the base **106** to form an intermediate region **120** therebetween which, in the present case, is a tapered region between an underside or lower surface **122** of the deck **110** and an upper surface **124** of the base **106**.

As shown in FIG. **3**, a plurality of support elements **126** are located within the intermediate region **120**. In the illustrated embodiment, the plurality of support elements **126** are integrally formed during manufacture of the tie plate **100**. However, in other embodiments one or more support elements **126** may be formed separately and inserted or otherwise located into the intermediate region **120**. For example, one or more support elements **126** may be individually or collectively inserted or otherwise located into the intermediate region **120** to support the deck **110**. Suitable support elements may include a bar, rail, rib, webbing, pillar, ball, sheet, grid, lattice, beam, rod, or a hollow structure.

Although in the present case the support elements **126** are made from the same material as the deck **110** and the base **106**, it is possible that other materials may be used. Examples of suitable materials include a rubber composition, foam, concrete, plastic, a composite material, metal, or an epoxy resin based material. In some embodiments, the material may include a resilient material which is inserted into the intermediate region **120** under compression.

In the present case, the support elements **126** are pillar (or column)-like elements which extend from the base **106** to the deck **110**. The pillar-like elements **128** are configured and arranged to support the deck **110** during use. Although in the present case the support elements **126** are illustrated and described as pillar-like elements **128**, it will of course be appreciated that other types of support elements may be used, including those referred to above. Other suitable support elements include rib-like elements, struts, webbing or the like. By using suitable support elements **126** within the intermediate region **120**, instead of a solid material mass, the weight of the tie plate **100** may be reduced without unduly compromising structural performance.

As is more clearly shown in FIGS. **2** and **3**, the pillar-like support elements **126** include a generally cylindrical body portion **129**. A base **130** and a head **132** are located at a bottom and top end respectively of the body portion **129**. The base **130** and the head **132** blend outwardly from the body portion **129** to form fillets **134** extending circumferentially about the cylindrical body portion **129** at the junction with the upper surface **124** of the base **106** and the lower surface **122** of the deck **110** respectively. The fillets **134** reduce stress concentration points and may improve manufacturability.

In the embodiment illustrated the plurality of support elements **126** are arranged in a uniform positional arrangement so that the support elements **126** are substantially equispaced. Furthermore, the plurality of support elements **126** have substantially the same horizontal cross-section. It is not essential that the support elements **126** be arranged in a uniform positional arrangement, nor it is essential that that they have the same cross-section configuration, since other arrangements and configurations may be possible which

nonetheless form the interposed region **120** and thus provide the required mechanical characteristics with a weight reduction.

As is shown more clearly in FIGS. **2** and **3**, the arrangement of the plurality of support elements **126** forms clearances **136** between the support elements **126**. In the present case, together these clearances **136** form a grid-shaped void so that the intermediate region **120** is partially hollow, and therefore the tie plate **100** is lighter than an equivalent solid tie plate. However, in other embodiments it is possible that the clearances **136** may be occupied by one or more additional support elements of a different material to the tie plate **100**, such as an insert or filler. Suitable materials may include a rubber composition, plastic, a composite material, metal, foam, concrete, sand or an epoxy resin based material. The filler may provide sound attenuation or assist in keeping water out of the clearances **136** for improved resistance to corrosion.

Including one or more additional support elements within the intermediate region **120** may further reinforce the deck **110** and thus further support the deck **110** during use and thereby further improve the ability of the tie plate **100** to transfer and distribute weight from the rail **102** to the sleeper **104**.

The tie plate **100** also includes flanges **138** of a conventional type. As shown, each flange **138** includes a pair of holes **140** for receiving conventional fastening means, such as a nail, bolt, or peg for securing the tie plate **100** to the sleeper **104** in a known manner. It is to be noted that other embodiments of the present invention may not include holes since other embodiments may be secured to a support member using other means, such as a spring clip or the like.

Referring now to FIGS. **6** through **8**, the tie plate **100** also includes landings **142** for locating rail retaining means **144**, for securing the rail **102** to the tie plate **100**. In the present case the landings **142** are illustrated in a simplified representation as mesa-shaped regions. However, it is to be appreciated that other suitable landing configurations may be used. Suitable landing configurations and retaining means for use therewith would be well understood by a skilled addressee.

The landings **142** are adapted to provide a base for anchoring a first end **146** of the rail retaining means **144**, so that, in use, a second end **148** of the rail retaining means **144**, is biased against the rail **102** to apply a retaining force to the rail foot **116**. The retaining force should be sufficient to hold the rail **102** in place on the upper surface **118** of the deck **110** even if the rail **102** should distort during hot weather temperatures. In the present case the rail retaining means **144** are resilient clip-type retainers. However, other suitable rail retaining means would be known to a skilled addressee.

In the embodiment illustrated in FIG. **6**, a pad **150** is located between the rail foot **116** and the upper surface **118** of the deck **110**. The pad **150** may include, for example, a rubber pad or a polymeric based pad.

The following Figures illustrate additional embodiments of the invention. Since a majority of the features shown in the following Figures are identical to features discussed above, they are denoted by the same reference numerals and will not be described again in detail.

Referring now to FIGS. **9** through **11**, where the assembly discussed above and illustrated in FIGS. **6** through **8** further comprises a base plate **160** for contact with the sleeper (not illustrated in FIGS. **9** through **11**), and a sheet of noise attenuating material **170** interposing the base plate **160** and the tie plate.

Whilst the base plate **160** illustrated is solid (see FIG. **11**), it could be produced with a lightening (ie. weight reducing) intermediate region interposing its upper and lower surfaces, in accordance with the inventive concept disclosed herein.

Referring now to FIGS. **12** through **14**, where there is illustrated a tie plate **200** according to a further embodiment of the invention disclosed herein. Structurally tie plate **200** shares a great deal of similarity with tie plate **100**, but differs in two key respects.

Firstly, the intermediate region **120** of tie plate **200** is concealed by way of being substantially enclosed by the tie plate **200**. As a result, the intermediate region **120** of tie plate **200** is not visible in FIG. **12**, but is visible in the sectional views provided in FIGS. **13** and **14**. As discussed previously, this intermediate region **120** may be concealed "as-cast", or it may be concealed by way of a further manufacturing process, such as by welding a cover plate over any opening to the intermediate region **120**.

Secondly, and as best illustrated in FIG. **14**, the intermediate region **120** of tie plate **200** is so extensive as to largely render tie plate **200** a shell for the intermediate region **120**. A plurality of support elements **126** extend between the base **106** and the deck **110** in a region below a receiving region **115** or "seat" for receiving the foot **116** of the rail **102**, but otherwise tie plate **200** is substantially hollow, although alternatively it may be filled with a dissimilar material to that from which the tie plate **200** is formed. For example, where tie plate **200** is manufactured using a casting process, tie plate **200** can be produced with a concealed intermediate region **120** 'as-cast", by leaving the core (not illustrated) which defines the intermediate region **120** during the casting process, in situ. This would still result in a tie plate **200** which is significantly lighter than an equivalent solid cast iron tie plate.

It will be appreciated by one of ordinary skill in the art in view of the disclosure provided herein that the invention can be utilized in various railway configurations. For example, the invention can be utilized in connection with different types of support members, such as concrete sleepers, timber sleepers, or plastic sleepers, or indeed other types of rail support members such as a concrete slab or the like.

Throughout the specification and the claims that follow, unless the context requires otherwise, the words "comprise" and "include" and variations such as "comprising" and "including" will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

It will be appreciated by those skilled in the art that the invention is not restricted in its use to the particular application described. Neither is the present invention restricted in its preferred embodiment with regard to the particular elements and/or features described or depicted herein. It will be appreciated that the invention is not limited to the embodiment or embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

The invention claimed is:

1. A support plate for supporting a railway rail on a rail support member, said support plate comprising a base comprising a lower surface via which the support plate is supported on a mounting surface of the rail support member, a deck disposed above the base and comprising an upper surface for supporting the rail and at least one shoulder for locating a foot of the rail, and an intermediate region interposing and separating the base and the deck, wherein the

intermediate region comprises a plurality of spaced apart columns, each of which extends from the base to the deck, for supporting the deck, wherein the base, the deck and the columns are made from a rigid material, and the intermediate region further comprises clearances that reduce support plate weight.

2. The support plate claim **1**, wherein the clearances form a void, so that the intermediate region comprises a hollow region.

3. The support plate of claim **2**, wherein the void is grid-shaped.

4. The support plate according to claim **1**, wherein the clearances in the intermediate region are at least partially occupied by a further material having different material properties to the deck and the base.

5. The support plate of claim **4**, wherein the further material forms a layer between the deck and the base.

6. The support plate according to claim **4**, wherein the further material includes at least one of:

a. a rubber composition;
b. plastic;
c. a composite material;
d. metal;
e. concrete;
f. foam;
g. an epoxy resin based material;
h. Sand.

7. The support plate as in claim **1**, wherein each column has substantially the same horizontal cross-section.

8. The support plate as in claim **1**, wherein each column comprises a generally cylindrical body.

9. The support plate as in claim **1**, wherein the columns are disposed in a substantially uniform arrangement.

10. The support plate as in claim **1**, wherein the support plate is of cast construction.

11. The support plate as in claim **1**, wherein the support plate is of fabricated construction.

12. The support plate as in claim **1**, wherein the intermediate region is substantially concealed.

13. The support plate as in claim **1**, wherein the support plate is one of an assembly of plates supporting a rail on a rail support member.

14. The support plate of claim **13**, wherein the support plate is a lowermost or base plate of the assembly.

15. The support plate as in claim **1**, wherein the support plate is a tie plate.

16. The support plate as in claim **1**, wherein the support plate is a turn out plate.

17. The support plate as in claim **1**, wherein the material of the support plate is made from a metal.

18. The support plate of claim **1**, wherein the base, the deck and the columns are made from the same rigid material.

19. The support plate of claim **1**, wherein the columns are arranged into a plurality of rows.

20. The support plate of claim **1**, wherein the columns are disposed in a non-uniform arrangement.

21. The support plate of claim **1**, wherein the columns are spaced throughout the intermediate region.

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